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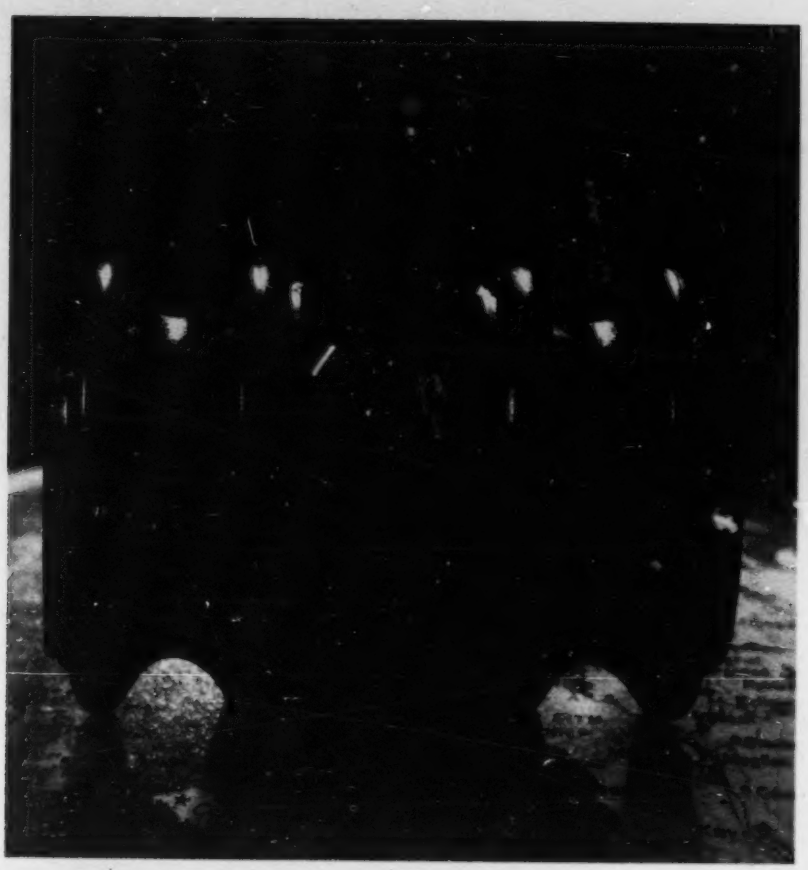

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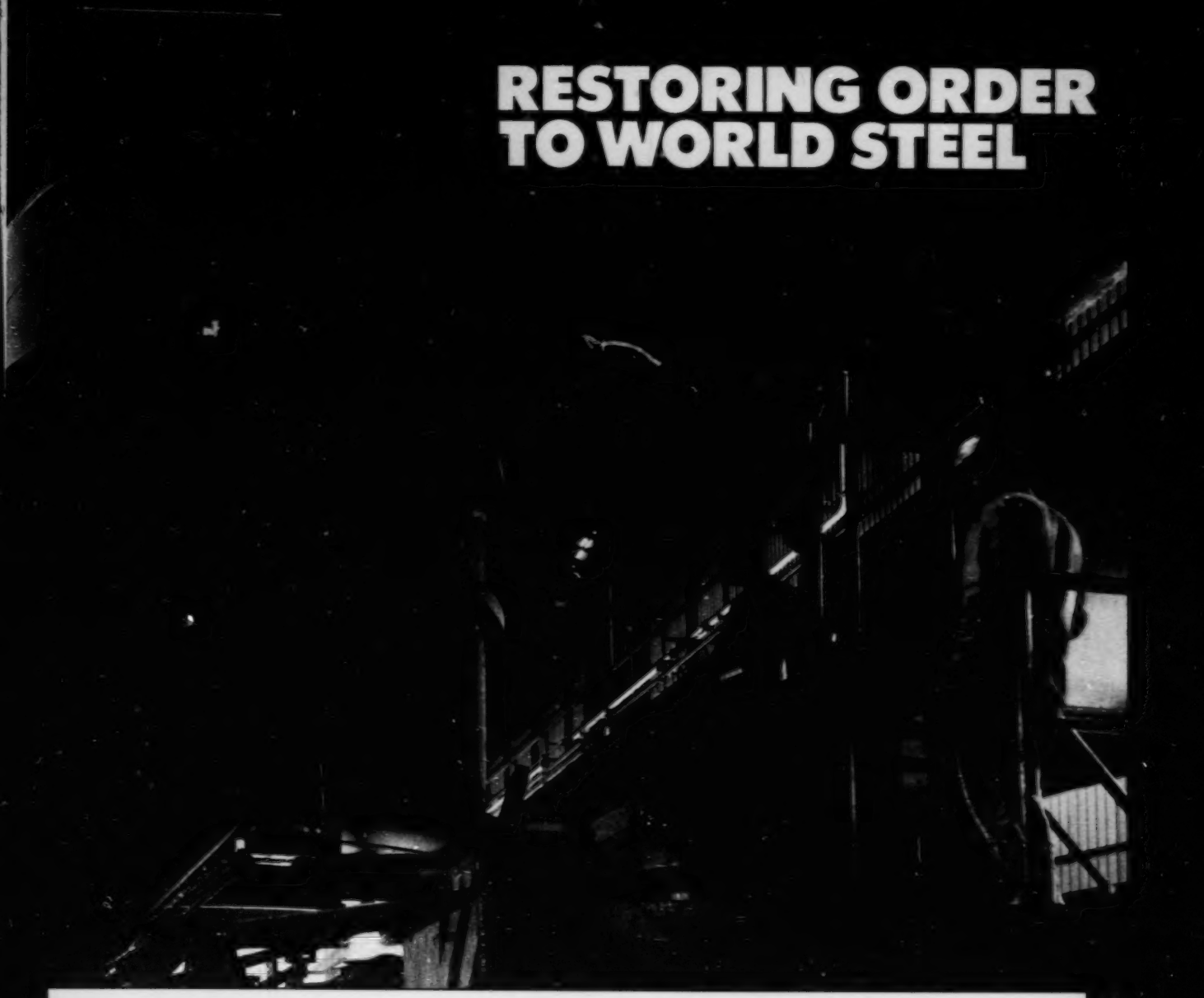
RESTORING ORDER TO WORLD STEEL



A REPORT FROM THE INTERNATIONAL IRON AND STEEL INSTITUTE MEETING

BY GEORGE MCMANUS

The Western World capacity of about 600 million tons is about 150 million tons greater than demand. IISI looks for this imbalance to continue through the rest of the decade; the world operating rate will be no more than 85 pct by 1990.

"We're not going to paper the world with steel trade agreements," said Commerce Secretary Malcolm Baldridge in early 1984.

The United States is now trying to negotiate a lot of steel trade agreements. Domestic producers only hope the government isn't papering over their problems with a lot of paper agreements.

The U.S. effort is a part of a general drive to restore order and profitability to the steel world. The Com-

STEEL CONSUMPTION/ PRODUCTION PATTERNS

IISI MEMBERS' COUNTRIES (29)
STEEL PRODUCTION, first 8 months
Millions of Metric Tons

	1984	1983	Pct Change 1984/83
EEC	79	70	+12.9
USA	60	49	+22.4
Japan	70	63	+11.1
Others	82	74	+10.8
Total	291	256	+13.7

mon Market is dealing with internal problems through a program that aims at eliminating excess capacity and government subsidies by the end of 1985.

The United States addressed part of its external problem in 1982 by securing a pact that limits steel imports from Europe. Recently announced by President Reagan was a program that seeks voluntary restraints on steel from Japan and the developing nations.

The affected countries have registered dismay, but the U.S. initiative really shouldn't be an occasion for surprise or outrage.

"We feel what Reagan is proposing is a normal procedure," said Pol Boel, administrator, Usines Gustave Boel SA of Belgium. "It affects us very little but I would say it is reasonable," said Mr. Boel, who heads the European Independent Steelworks Assn. (EISA).

The Reagan plan is considered reasonable and normal because it merely closes the one open loop in a world-wide network. "I think the bilateral agreements which European countries have with other steel producing parts of the world are probably more effective and comprehensive than what the American steel companies have at the present time," said Charles E. Schueppert, chairman of Sheerness Steel Co. Plc. of Great Britain.

Steel shipments into the Common Market are restricted by some 15 bilateral agreements. Taking in Japan as well as the developing nations, the agreements have been public knowledge for some time but seldom come up in discussions of U.S. trade policy.

To free trade purists, none of this is very nice. The world's steel producers are seen working out cozy deals that stifle competition and bilk the customer.

The fact is that the various pacts have been brought on by an excess of competition. And steel producers have never succeeded in bilking anyone. In the U.S., consumers have been able to buy domestic steel at $6 billion under cost for the last three years. That's how much the steel industry has lost since the start of 1982.

Outside the U.S., European steel companies sold their product for $3 billion under cost from 1981 through 1983. To free traders, this is great. 'Why should we deprive our manufacturers of the bargain prices on imports?', they ask.

Because you can't get something for nothing, said Donald H. Trautlein, chairman of Bethlehem Steel Corp. and of the American Iron & Steel Institute.

"Over the long term," said Mr. Trautlein, "the market has to pay a price for a product or you don't have a product. The market's not doing that now for all the steel that's coming into this country."

The fallacy in this statement has been that government subsidies can enable a company to give its product away for an indefinite period. That has been happening, but a day of reckoning may be approaching in the Common Market.

"The subsidies are being turned off," said Mr. Boel. "They have to end at the end of 1985. This has been coupled with a very strong restructuring."

He indicated the subsidy deadline was backed by heavy popular pressure. "It's certainly something that's going to stop because the taxpayer in Europe is getting sick of paying for the steel industry," he said.

British Steel Corp. has made genuine progress in restructuring and in putting operations on a solvent basis. In the past 10 years or so, the capacity of British Steel has been reduced from 27 million tons to under 15 million tons. Employment has been cut from 220,000 to 68,000.

The contraction has gone a long way towards making the company financially self-sufficient. "We would be in the black except for the coal strike," said Robert Haslam, chairman of British Steel.

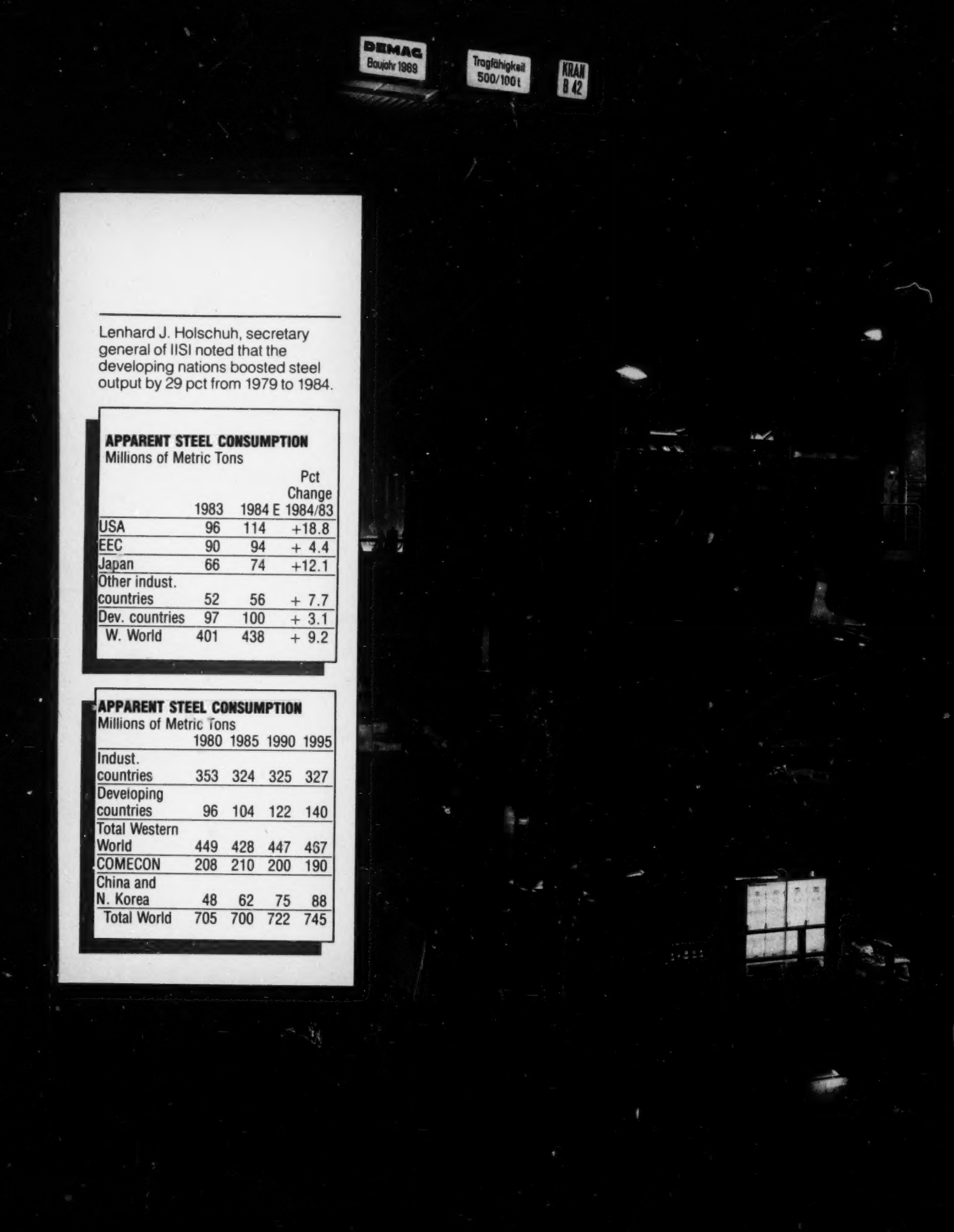
Speaking in October, Mr. Haslam pointed out that part of the subsidy money has really been going to the elimination of subsidies. More spe-

APPARENT STEEL CONSUMPTION
per cent per year change

	1980/85	1985/1995
Indust. countries	−1.7	+0.1
Dev. countries	+1.6	+3.0
Total W. World	−0.8	+0.9
COMECON	+0.2	−1.0
China and N. Korea	+5.3	+3.0
Total World	−0.1	+0.6

APPARENT STEEL CONSUMPTION
Millions of Metric Tons

	1984 E	1985	Pct Change 1985/84
EEC	94	94	—
Other W. Europe	31	32	+3.2
USA	114	112	−1.8
Japan	74	74	—
Other ind. countries	25	25	—
Total	338	337	−0.3



Lenhard J. Holschuh, secretary general of IISI noted that the developing nations boosted steel output by 29 pct from 1979 to 1984.

APPARENT STEEL CONSUMPTION
Millions of Metric Tons

	1983	1984 E	Pct Change 1984/83
USA	96	114	+18.8
EEC	90	94	+ 4.4
Japan	66	74	+12.1
Other indust. countries	52	56	+ 7.7
Dev. countries	97	100	+ 3.1
W. World	401	438	+ 9.2

APPARENT STEEL CONSUMPTION
Millions of Metric Tons

	1980	1985	1990	1995
Indust. countries	353	324	325	327
Developing countries	96	104	122	140
Total Western World	449	428	447	467
COMECON	208	210	200	190
China and N. Korea	48	62	75	88
Total World	705	700	722	745

cifically, the money has been going to displaced workers; the cost of eliminating jobs in Great Britain is $12,900 a man. Of the $300 million subsidy for British Steel this year, said Mr. Haslam, about half is for job cuts.

He said British Steel has been spinning off component operations and setting them up as private companies. Finally, Mr. Haslam noted one of the reasons the American market is so attractive to outsiders, is with only one currency, he said, the U.S. doesn't have the constant price changes that result from fluctuating exchange rates in Europe.

"It's much easier to make money in the United States," said Mr. Haslam, who once worked in America in the chemical business.

It hasn't been easy for American steel companies to make money, and U.S. producers aren't counting on foreign restructuring to solve their problems. The drastic surgery of Britain is acknowledged, but France and Italy are seen dragging their feet. U.S. producers doubt that steel companies on the continent will meet the 1985 deadline for trimming excess capacity and ending subsidies.

"When you say a year and a half, I don't think they have a Chinaman's chance," said David M. Roderick, chairman of United States Steel Corp. "It's very difficult to get out of a subsidized mode. It just breeds inefficiency."

"They certainly aren't going to have the restructuring completed by the end of '85," said Mr. Trautlein of Bethlehem. "Subsidies are now taking place in Germany, the one country that didn't have many. They're pumping millions into their industry."

The question of timing is important because the agreement which now limits European shipments to the U.S. is scheduled to end in 1985. The idea was that the subsidies would end then, too.

"It seems to me that the agreement would be subject to extention," said Mr. Trautlein. "If it weren't, we'd just refile the trade

WESTERN WORLD LIQUID STEELMAKING CAPACITY
Millions of Metric Tons

	1974	1980	1990
W. Europe	203	223	181/191
N. America	156	152	136/142
Japan	126	142	130/135
Dev. countries	33	60	104/116
Others	15	18	20/26
Total	533	595	571/610

CONTINUOUS CASTING
(Pct of Total Crude Steel)

	1973	1983
Japan	20.7	86.2
USA	6.8	32.1
EEC	9.4	60.4

YIELD: Finished products as percentage of crude steel production

	1973	1983	Difference
Japan	83.7	91.6	+7.9
USA	73.9	79.1	+5.2
EEC	74.3	79.0	+4.7

Continuous casting capacity over the past decade increased dramatically.

A DECADE OF DISASTER FOR STEEL
Comparison of Financial Performance

Average	Sales	Profits	Crude Steel Production	Profit or Loss Per Ton Produced
	(Millions of Dollars)		(Millions of Net Tons)	(Dollars Per Net Ton)
U.S. (AISI Reporting Companies)				
1975-77	36,212	985	111.0	9
1978-80	52,334	1,389	112.3	12
1981-83	53,568	−1,389	77.4	−18
EEC (10 Companies)				
1975-77	22,932	−1,664	79.7	−21
1978-80	34,693	−2,552	82.2	−31
1981-83	25,506	−3,176	75.5	−42
Japan (5 Companies)				
1975-77	24,084	184	89.4	2
1978-80	33,242	864	86.9	10
1981-83	33,604	376	75.4	5
Canada (3 Companies)				
1975-77	2,685	181	11.7	15
1978-80	3,743	299	13.0	23
1981-83	3,897	107	10.9	10

Source: Bethlehem Steel Corp.

NOTE: The financial performance of major world steel producers has ranged from unacceptable to outright disastrous over the last nine years. Canadian companies have fared the best—benefitting from a closely monitored import market and practically unlimited access to the U.S. market. U.S. producers have been especially vulnerable over the last few years as surging levels of unfairly priced imports have eroded domestic prices, producing mounting losses.

It hasn't been easy for companies in the steel industry to make money.

cases and shut them out of the market completely."

Reagan Program

As in the past, the American trade situation was brought to a head in 1984 by the threat of complete exclusion, or at least, a very sharp reduction. U.S. producers had gathered considerable support for a legislated import quota. Numerous dumping and subsidy suits were nearing the action stage. Also calling for action in September was the injury case started by Bethlehem Steel and United Steelworkers of America.

In this case, the International Trade Commission recommended quotas for about two-thirds of the steel products. Other grades were omitted and the quotas for plates and structurals was so high they were almost meaningless.

No one was very happy with the ITC proposals, but they served the purpose of forcing the Reagan Administration to deal with steel trade issues a few weeks before the national election. Apart from political consequences, a complete dismissal of these issues could have brought on a legislated quota and would certainly have brought some tough rulings in the unfair trade cases.

In this situation, the Reagan Administration came up with a plan for restricting steel imports through voluntary bilateral agreements. Imports of finished steel would be limited to 18.5 pct of U.S. supply and another 1.7 million tons of semi-semifinished steel would be admitted.

In return, domestic producers agreed to withdraw their unfair trade suits on finished steel. Trade suits can and will be filed on semi-finished grades.

"We intend to file subsidy and dumping cases against semifinished," said Mr. Roderick.

U.S. Steel has been nothing if not flexible in its attitude toward semi-finished imports. When the trade agreement with Europe was being negotiated, Mr. Roderick reportedly argued strenuously for limits on semifinished products. When these weren't applied, U.S. Steel almost immediately made plans for bring-

"Over the long term the market has to pay a price for a product or you don't have a product,"
Donald Trautlein, chairman of Bethlehem Steel Corp.

ing forging slabs into the Fairless Works.

The initial Fairless plan fell through, and now Mr. Roderick plans to sue people for importing slabs. An interesting sidelight is that dumping duties and countervailing duties are paid by the importers of record. In the case of semifinished steel, the importers could very well be domestic steel companies.

California Steel, which used to be Kaiser Steel, has been set up to run on foreign slabs. With over 800,000 tons of semifinished imported in 1984, other domestic mills have to be using foreign material.

American steel producers would obviously have preferred a formal quota and a lower limit on imports, but some action was urgently needed and the Reagan program was considered a lot better than nothing. Imports captured 26 pct of the U.S. market in the first nine months of 1984 and went over 30 pct in individual months. Without government intervention, it's conceivable the foreign share would have gone to 40 or 50 pct.

The effectiveness of the voluntary program will depend on the will of the Administration. The President is "deadly serious" about the import limits, said Mr. Trautlein. "You certainly don't mistrust your President when he tells you face to face that he's committed to that program."

Nevertheless, it will take a good deal of doing to devise workable restraints. So far neither trade suits nor agreements have succeeded in eliminating excess production and competition in the world market.

Agonizing Ordeal

"The world steel industry has never before experienced in its history as a modern industry a more agonizing ordeal than it does today," said Yutaka Takeda, president of Nippon Steel Corp. and chairman of the International Iron and Steel Institute (IISI).

The problem remains one of not enough demand. According to IISI, Western World steel consumption of 438 million tons in 1984 will be up a little from 1983, but it will be well below the 1979 peak. Moreover, part of what appeared to be a consumption increase turned out to be inventory building by U.S. manufacturers early in 1984.

In any case, Western World steel capacity of about 600 million tons is about 150 million tons greater than demand. IISI looks for this imbalance to continue through the rest of the decade; the world operating rate will be more than 85 pct by 1990, the organization said.

There is a tendency to attribute steel problems to overbuilding by a mature industry serving mature economies. That is partly true, but some of the worst problems have arisen in the immature economies of developing nations.

"Apparent steel consumption in Latin America has suffered severe setbacks," said Lenhard J. Holschuh, secretary general of IISI.

At the same time, the developing countries have been under financial pressure to maintain steel output. "Recent estimates put the external debt of the developing countries at $608 billion in 1984, rising to $645 billion in 1985," said Mr. Holschuh. "The Third World's 1985 debt service payments will absorb one-third of its export earnings next year."

The fact that U.S. lenders are among those receiving debt payments has unquestionably added to the country's free trade constituency.

The net effect of all this was that the developing nations boosted steel production by 29 pct from 1979 to 1984—even though their own economies were weak. In the same period, the Western World market shrank by more than 10 pct. The developing world's share of the free market rose from 9.5 pct in 1979 to 13.7 pct in 1984.

The Reagan Program vs The Trade Bill

Comprehensive Fair Trade Program

1. The U.S. Trade Representative will engage steel export nations in negotiations designed to arrive at country-by-country arrangements or agreements that will be enforceable under our laws.

2. The Administration will introduce and support the prompt enactment of legislation that will make any such arrangements and agreements enforceable by Customs at our borders.

3. The objective of these enforceable arrangements and agreements will be imports of steel mill products, other than semi-finished steel products, of not more than 18.5% of apparent domestic consumption. For semi-finished steel products, the import level will be not more than 1.7 million tons, with the possibility of increased amounts if the steel industry operating rate is above 85%. Imports entered into this country on or after October 1, 1984 will be included in the imports covered by the Program.

4. The Government will obtain reaffirmation of existing unfair trade case arrangements and agreements previously concluded with the European Community, Mexico, and South Africa. Necessary action will be taken to assure adherence to the pipe and tube agreement between the European Community and the United States.

5. The arrangements and agreements will cover all steel mill products and will be product specific in order to maintain a product mix that is representative of historic patterns.

6. The Program will be for a period of five years and includes the presumption of renewals.

7. The Administration will use the authority of our laws to achieve the Program, including Section 301 of our trade statutes, the self initiation of antidumping and countervailing duty cases, and the full use of all of our fair trade powers to obtain the arrangements and agreements.

8. There will be a Cabinet-level monitoring group to review the arrangements and agreements reached and to monitor import trends on a quarterly basis to insure that the Program is realized.

9. The Administration will provide additional initiatives to assist the steel industry by making a comprehensive review of domestic tax, regulatory, and antitrust laws and policies, with a view to corrective changes in 1985. Furthermore, the U. S. Trade Representative will make new initiatives to eliminate restrictive and distortive trade practices against steel suppliers by foreign countries.

10. Unfair trade cases, except as to semi-finished steel imports, will not be filed against a country so long as there is satisfactory progress with respect to such country in achieving the Program.

International Trade Bill

Urges the President, through a non-binding resolution, to reduce the import share of all products in the domestic steel market to a range of 17 pct. to 20.2 pct.

Gives the President the authority to enforce voluntary restraint agreements through export licenses or the U. S. Customs Service.

Requires the domestic steel industry, as a condition for annual renewed import relief, to commit "substantially" all of the net cash flow from its steel operations to investment in facility modernization.

Requires the domestic steel industry to set aside 1% of its net cash flow for employee retraining.

Requires the U. S. Department of Labor to devise a plan within six months for the retraining and relocation of unemployed steelworkers unlikely to return to work in the industry.

The big loser in this sequence was the American steel industry. U.S. imports from the developing nations rose from 4 million tons in 1982 to 6.3 million tons in 1983 and to an estimated 10.5 million tons in 1984. These gains in depressed market had a murderous effect on domestic mills.

During the first two years of the recession, Japanese and European producers exercised voluntary or involuntary restraint. In 1984, however, Japan joined the party, boosting shipments to the U.S. by 80 pct in the first nine months of 1984.

Imports from Europe were up by a smaller amount—60 pct. With a 76 pct increase in third world shipments, the market sagged under a big inventory burden and there were angry protests from domestic producers.

Foreign mills have "opened the floodgates and are pouring steel into the U.S.," said Mr. Trautlein.

How to Control

Recent experience has provided some guidance on what kind of instruments are effective in closing the gates. Not very helpful are agreements that are vague, private and possibly non-existent.

The understanding which supposedly limited Japan's shipments to the U.S. is one example. This has often been treated as something firm and clearcut. In discussions of trade policy, it has been argued that the

Japanese and European agreements mean the U.S. was already controlling two-thirds of its steel imports.

However, no one ever knew if there was an agreement or what the terms were. "It's just something that is very vague," said Mr. Roderick.

"There hasn't been any agreement whatsoever to restrict the volume between Japan and the United States," said Minoru Kanao, president of Nippon Kokan (NKK). "We have been looking into past numbers on our own—on an individual company basis—and we have been discreet with our exports to the United States."

Asked about the 80 pct surge in Japan's U.S. exports, Mr. Kanao said it reflected the economic improvement. Speaking in October, he said the second half of 1984 would see the exports coming down.

"We have no intention of flooding the United States market with our steel," he said.

The good intentions of Nippon Kokan are now backed by a direct stake in the U.S. market. NKK now owns 50 pct of National Steel. The other owner, National Intergroup, recently revealed that it was merging with a West Coast distributor of pharmaceutical products.

"National told us they were going to merge," said Mr. Kanao. "The relationship between National Steel and National Intergroup will remain unchanged."

There are no immediate plans for changing NKK's position in National Steel. "At this moment, we have no idea of buying the other half," said Mr. Kanao.

Other Japanese steel companies are said to be looking at U.S. investments, and the establishing of multinational ties may ease trade pressures in the future. Right now, governmental restraints are considered necessary.

What Works

The European agreement illustrates the kind of restraint that works and the kind that doesn't. On most major products, the agreement provides specific limits and monitoring procedures. Steel exports to the U.S. must be licensed by the Common Market. Under special legislation, the U.S. can turn back shipments that violate the agreement.

The Europeans have complied with this portion of the agreement. They haven't complied with the portion which provides a specific limit for tubular products but has no monitoring or enforcement provision. Tubular shipments have gone through the roof. Imports from sources have taken over nearly 70 pct of the oil country seamless market.

A third portion of the European agreement dealt with a number of minor products by saying there should be consultations if the specified limits weren't respected. Needless to say, this has proved to be just another example of American innocence in the grown-up world.

The agreements called for under the Reagan program are supposed to have licensing procedures. Enforcement authority has been provided by recent legislation.

The question, of course, is whether Japan and the developing countries will go along with effective restraints. U.S. producers say they have the goods on all countries in trade suits.

"There's plenty of leverage for all of them," said Mr. Trautlein. "There are plenty of ways. What there hasn't been is the will."

The U.S. government is now apparently willing to intervene in steel trade. In securing this willingness, U.S. producers could have invited an elephant into their tent. The new trade bill calls for steel companies to plough back steel earnings and provide funds for retraining.

These are considered innocuous provisions, but they do suggest the quid pro quo for trade protection will be suspicious surveillance of steel company actions. In October, Mr. Roderick noted some of the items under consideration for the trade bill.

"They're going to monitor price behavior and they're also going to monitor employment costs," he said.

With steel prices behaving so badly and with President Reagan in office, the question of jawbone control is academic. If steel companies are ever able to restore prices, however, you can be sure there will be cries, that trade protection has led to non-competitive actions by domestic mills. □

"The world steel industry has never before experienced in its history a more agonizing ordeal than it does today,"
Yutaka Takeda, president, Nippon Steel Corp. and Chairman of IISI.

Big and Basic

With all the troubles of the world steel industry, people sometimes lose sight of two important points.

First, the steel market is enormous. Over 710 million tons of steel will be consumed in the world in 1984. Western World consumption will be 441 million tons and the U. S. will consume 94 million tons (metric).

The second point is that steel is basic. It's basic because it costs less than other materials. This fact was touched on by Yutaka Takeda, president of Nippon Steel Corp. and chairman of IISI.

Mr. Takeda compared steel with other materials on the basis of "price relative to specific strength."

"In the case of steel," he said, "this is 8 cents, whereas for aluminum, it is 29 cents; for ceramics, it is 30 cents; for carbon fiber, it is 38 cents; and for titanium, it is $1.25."

"...we may safely say and expect that steel will continue to command an unshakeable position as the basic industrial material...," said Mr. Takeda.

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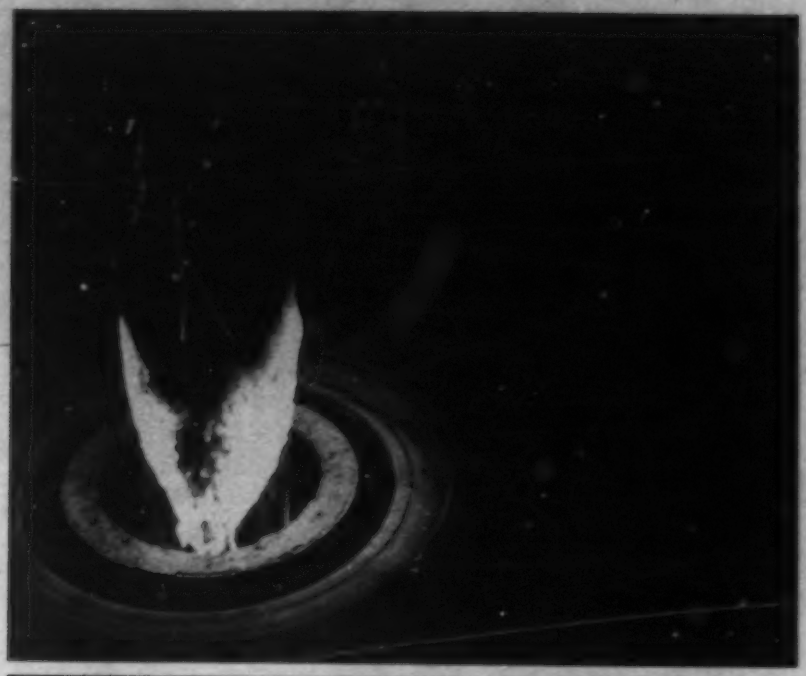

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ELECTRIC FURNACE REPORT:

A PIPELINE FULL OF TECHNOLOGY

Technology Changes In Arc Furnace Steelmaking

Change	United States	Japan
Up-powering	Values over 0.6 MVA MT	Yes
Oxy-fuel burner use	Limited	Yes
Scrap preheating	No	Yes
Power cable cooling	Yes	Yes
Slag door/tapping spout weight reduction, water cooled elec holder	Yes	Yes
Bucket vacuum refining	Limited	Yes
Arc shielded welding	Yes	Yes

With the whole steel market expected to lag over the rest of the decade, the electric furnace surplus is likely to continue.

BY GEORGE J. MCMANUS

The electric furnace faces a new challenge.

The challenge is to continue making technical progress with little or no expansion of capacity.

Dramatic progress in the last fifteen years has been accompanied by rapid expansion. In 1981, alone, thirteen new arc furnaces came on stream.

The construction spree lifted electric furnace capacity to about 50 million tons. That compares with a market of 20 to 30 million tons in the last three years.

With the whole steel market expected to lag over the rest of the decade, the electric furnace surplus is likely to continue. There will probably be some further displacement of blast furnaces, but to a large extent, electric furnace activity will have to be based on replacement and modernization.

It has always been difficult to justify replacement spending in the steel industry. Without the prospect of added volume, few projects have been considered attractive.

Happily, the electric furnace pipeline is filled with a great amount of exciting, compelling technology. For existing furnaces, there are water cooled walls, oxy-fuel burners, computerized controls and other advances.

Furnace builders say production rates can be doubled with relatively modest investments. Payback periods of a year or so are cited.

In addition, a number of completely new processes are being tried. The direct current furnace is now getting a production scale test in the U.S. Continuous steelmaking has surfaced again. In Europe two plasma furnaces are being operated.

It will be some time before economic and technical questions on these processes have been evaluated. There are those who doubt that the conventional arc furnace will be seriously challenged.

There are questions, but the potential in the new technology is too great to be ignored. With conventional combustion or electricity, the highest temperature achievable is 3,500°C. With plasma, temperatures over 15,000°C. can be generated.

It has been suggested that the intense heat of plasma could be used to make steel refine itself. The components of iron ore would simply be distilled off.

No one is trying to exploit the more exotic possibilities of plasma just now. On the other hand, no one in the metals business can afford to ignore a process that could bring on a whole new technology.

None of which means there is a concerted rush to upgrade electric furnaces. Except for the related field of ladle refining, things are slow. But there is the economic and technical basis for continued progress.

World Steel Production By Process

Source: Airco Carbon

Year	Steel Production, (Millions of Metric Tons)		
	Total	Hot Metal Processes	Electric Furnace
1975	643.0	531.8	111.2
1976	675.4	554.1	121.3
1977	669.7	543.1	126.6
1978	716.7	569.5	147.2
1979	745.3	584.1	161.2
1980	711.6	552.5	159.1
1981	704.0	543.7	160.3
1982	643.1	495.2	147.9
1983 Preliminary	663.0	510.8	152.2
1984 Estimate	704.3	537.8	166.5
10-Year Average	687.6	542.3	145.4

Electric furnace share of *world* steelmaking has risen from 17.3 per cent in 1975 to an estimated 23.6 per cent today.

PROFILE OF A SYSTEM: There is close coordination in the B&W complex, but the individual operations are still controlled separately.

In February of 1984, Babcock & Wilcox began operating a new steel complex at Koppel, Pa.

This included an 80-ton, UHP Krupp arc furnace with a 19 foot diameter; a Midland-Ross ladle furnace; and a four-strand Mecan Arbed-Ksw bloom and bar caster.

The 80-ton furnace has produced heats in as little as 62 minutes tap-to-tap. This speed reflects radical changes in the function and design of the modern electric furnace. The new role is explained by Lowell S. Gonano.

"You melt scrap," said Mr. Gonano, of Babcock & Wilcox. "You blow your oxygen. You superheat it and tap it. What you're doing there is melting fast.

"Then we reladle so that the furnace slag isn't going into the ladle furnace. Your ladle furnace is where you concentrate on producing a specific analysis-temperature, deoxidation.

"So you've got the best of both worlds. You've taken the tedious tasks, which it couldn't do very well, away from the arc furnace. You've put them over in a furnace where you can precisely control everything."

By precise, Mr. Gonano means chemistry "right to the point. And if I want 2,875°F for the caster, I've

got 2,875. There's no surprise up there."

As this suggests, the role of the arc furnace is being changed by ladle refining. The furnace, itself, is being changed by ultra high power, water cooling and other innovations.

All this adds up to a furnace so fast and powerful manual control is difficult or impossible.

"That's like taking a man who learned to fly a Piper Cub and throwing him in a Mach Two airplane," said Mr. Gonano. "He's going to have a helluva time keeping up with it. And with these big transformers you're putting on furnaces these days, you could melt the shop down if you weren't careful."

The Krupp furnace at B&W has a computer control that does more than generate information.

"This one runs the furnace," said Mr. Gonano. "The man doesn't run it. He puts it on automatic and away it goes. The computer controls the tap settings. It has sensors on all the panels. It has sensors in the roof and as long as you're running a good, foamy slag, that thing will stay on pretty high current.

"If something goes astray and one side gets a little hot, the computer knocks the tap down. That's a very good feature on our furnace."

The Krupp control system was developed at that company's Siegen Geisweld plant where a 122-ton furnace set a record of 20 heats in one day. The control is the adaptive, dynamic type.

"The kilowatt hours and time needed to finish a heat are updated and displayed every 10 seconds," said Heinz Gremme, manager of process automation for Krupp Stahltechnik.

"We have at Babcock & Wilcox a historical data base," continued Mr. Gremme. "It provides the operator with access to the schedules. The ladle refiner operator can look into the caster schedule as well as the furnace schedule.

"He gets the data on where they are just now. If the computer predicts they will need another 10 minutes to do a heat, he doesn't have to do all this phone calling."

There is close coordination in the B&W complex, but the individual operations are still controlled separately. "The next step would be to combine all that in a planning algorithm," said Mr. Gremme.

CONVENTIONAL R&D: Tending to discourage applications of any technology is the amount of electric furnace capacity in place.

"What the steel industry needs now is to optimize what they have," said James W. Brown, director of market development, Electrode Systems Division, Union Carbide Corp.

Mr. Brown has more than a passing interest in electric furnace technical trends; Union Carbide supplies electrodes that would be displaced by some new processes; but it does seem logical to make use of existing technology before deciding new technology is better.

Tending to discourage applications of any technology is the amount of electric furnace capacity in place. "I would say it's around 48 to 50 million tons," said Mr. Brown.

That's well above 1984 electric furnace production of about 30 million tons. The surplus has registered in the equipment market.

"As far as new electric furnace business, it's slow," said William J. Bottomley, executive vice president and general manager, Lectromelt Corp. "What we see in general is the emphasis on upgrading and improving efficiencies, improving quality capabilities."

There may be some emphasis on upgrading, but furnace builders don't think melt shops are taking full advantage of the opportunities available through modernization. Mr. Bottomley speaks of getting from one furnace the same output that had been coming from two.

Others agree. A lot of the U.S. electric furnaces are 10 to 15 years old, said Ralph M. Smailer, manager of electric arc furnaces for the Swindell Furnace Division, Davy McKee Equipment Corp.

"Almost half are suitable for upgrading," said Mr. Smailer. "On any of the these furnaces, you can look at doubling output."

He cited the experience of Lukens Steel, which was able to get a 70 pct furnace increase through modernization. Mr. Brown said the various innovations translated into another 10 million tons of electric furnace capacity.

One way of boosting output is to relieve the arc furnace of refining chores by installing a ladle system. This approach has produced 35 pct gains for Japanese furnaces that were good to start with, said Mr. Smailer.

Swindell supplies the ladle technology of Daido Steel. The company recently received a contract from U.S. Steel for a ladle system at Gary Works.

Lowell Gonano of B&W noted that some operators balk at the cost of ladle systems. "I'll tell you: once you've got one running in there, it's saving you money every day," he said.

Daido's process control for arc furnaces is now being supplied by Bricmont & Associates and is going in at Cascade Steel Rolling Mills, Inc., McMinnville, Ore.

"We have data from the Japanese where they have reduced electrode consumption 10 to 25 pct," said F.H. Bricmont, chairman of The Bricmont Company. This was on furnaces that had low consumption before, said Mr. Bricmont. Reduced graphite consumption means reduced power consumption, he said.

Mr. Brown of Union Carbide noted that economic justifications of new processes have used electrode consumption of about 10 pounds per ton of steel for conventional furnaces.

"If you take the better run, more modern operations today, you will find they are getting electrode consumption on the order of 6 to 7 1/2 pounds a ton," he said.

Studies by Airco Carbon showed that from 1970 to 1983, U.S. electrode consumption fell from 13.6 lbs per ton to 10.2 lbs per ton. How-

ever, there are 15 U.S. furnaces with consumption below 8 lbs per ton. In Japan, the average is 8 lbs and some furnaces go below 4 lbs per pounds.

Nearly half the improvement has been due to better electrodes, Airco Carbon said. The company noted that neither the Japanese nor the U.S. numbers had yet reflected the benefits of water cooled or coated electrodes.

Water cooled electrodes haven't caught on so far in the U.S. One reason may be the advent of protective coatings. Nalco Chemical Co. reports that its coating can reduce graphite consumption 9 to 15 pct.

The benefit of water cooled furnace roofs and side walls are now generally accepted. "It's almost standard practice," said C.H. Freudenrich, sales manager for Blaw-Knox Equipment. "All plants are going to have it if they have the water available."

Oxy-fuel burners are finding limited use in the U.S. In June of 1984, Empire-Detroit installed an oxy-fuel system on its number 8 furnace at Mansfield, Ohio. The system was supplied by Korf Technologies and Air Products and Chemicals, Inc.

In the first three months of operation, the furnace with three burners outproduced a comparable furnace by 15 pct. Electrical consumption was reduced by about 40 kwh a ton. A slight increase in electrode consumption was expected to be minimized with more experience.

Foamy slags are being used to protect furnace sidewalls from arc radiation. By injecting carbon and combining it with oxygen, a foam a foot or more thick can be formed.

Direct reduced iron, with its oxygen and carbon content, provides a ready-made source of the foaming action.

While most of the current activity involves the upgrading of existing furnaces, there are some complete new furnaces in the picture. The 80 ton Krupp furnace at B&W came on stream in early 1984. Scheduled for startup in October of 1985 is the Krupp furnace at Timken's Faircrest greenfield plant.

CONTINUOUS STEEL:

At the new Babcock and Wilcox Shop, 80-ton heats have been turned out in a little over an hour.

At the electric furnace conference in Toronto, a paper on continuous steelmaking was presented by John A. Vallomy, president, Intersteel Technology, Inc.

Mr. Vallomy said his concept could boost productivity 150 pct and could reduce capital costs as much as 50 pct.

These comments were received with interest. Electric furnace people indicated they would look forward to data from a demonstration plant.

The idea of continuous steelmaking isn't brand new. In France, IRSID worked for years on a continuous process. There was an extensive program in Australia.

Nothing came of these projects. "You can almost make steel in a continuous process," was the comment of one engineer. To make the different steel grades, you had to go to some kind of batch treatment, he indicated.

Nevertheless, continuous steelmaking is coming close to reality. The speed with which the new high powered furnaces make steel is starting to approach continuity. At the new Babcock & Wilcox shop, 80-ton heats have been turned out in a little over an hour.

Lowell Gonano of B&W is still happy to have a batch refining ladle between the furnace and the continuous caster. "Steel mill equipment takes a lot of abuse," said Mr. Gonano. "The more technical pieces you put on it, the more things that can go wrong.

"Maybe I'm old fashioned," he continued, "but somewhere you have to allow batches to occur so you can take 10-minute or a one-hour breakdown and not screw the whole place up for the day. I can absorb an hour downtime and not have a catastrophy."

Increased use of direct reduced iron would favor continuous steelmaking. "With DRI, you're charging a known chemistry and its physical form lends itself to continuous charging," said Mr. Bottomley of Lectromelt. "You can maintain a foamy slag; you have a certain amount of iron oxide and a certain amount of carbon in the product."

The metallized pellets can be continuously charged, he explained. The known chemistry makes it possible to predict end points and minimize refining.

Mr. Bottomley was formerly with Oregon Steel. "Not too many people are aware of it," he said, "but there was an experiment at Oregon Steel some years ago on continuous steelmaking.

At that time, Oregon Steel was using reduced iron. "The actual process was one of melting DRI in a furnace on a continuous basis," said Mr. Bottomley. "The steel was decarburized continuously and then went into a holding furnace.

"The difficulties were in the holding furnace. Holding low carbon steel is a difficult task. It's difficult from a refractory standpoint. This particular experiment employed an induction furnace as a holding furnace and that was the weak link."

There were problems, but the main difficulty, Mr. Bottomley indicated, is that natural gas prices have worked against direct reduction in the industrialized world.

"If DRI were readily available and economically competitive with scrap," he said, "I'm sure someone would figure out a way to achieve long runs with continuous melting. It's not that far away."

DIRECT CURRENT:

What needs to be shown is that the DC concept is practical for making steel on a production basis.

Scheduled for startup in early 1985 (or late '84) is a direct current furnace at the Darlington, S.C., plant of Nucor Corp.

If results are favorable, the impact could be enormous. "The main advantage is reduced graphite consumption," said Ernest G. Mueller, manager applications engineering, BBC Brown Boveri, Inc. "This is about half or more than half."

Brown Boveri and the American Bridge division of U.S. Steel are supplying the direct current furnace to Nucor. Assuming 8 to 10 pounds of graphite per ton of steel in an AC furnace, Mr. Mueller's consumption estimate translates into a saving of more than $8 a ton with direct current.

The saving stems from the switch from three electrodes with alternating current to one electrode with direct current. The DC furnace has higher capital costs, but the net saving can still be significant.

What needs to be shown is that the DC concept is practical for making steel on a production basis. Brown Boveri's experience has been on a 15-ton prototype furnace at a foundry in the Buschhutten Works of SMS Schloemann-Siemag AG.

At Avesta in Sweden, a 50-ton specialty steel furnace was converted to the direct current process of Krupp and ASEA. This would have provided some answers, but Avesta has gone back to AC operation. An ASEA DC furnace with a hollow electrode is being used for ferrochrome.

There could be another installation soon—in the U.S. "We're working on a project," said Patrick Hanley, manager of steelmaking for ASEA Metallurgy.

At the moment, however, everyone is waiting to see what happens at Nucor. Brown-Boveri and American Bridge are encouraged by results on the 15-ton foundry furnace.

"The experience has been very good," said Mr. Mueller. "It really confirms our expectations. It did prove the reliability of the concept."

Full confirmation will only come when the larger (35-ton) more powerful (37.5 kilowatts) furnace at Nucor is in operation.

"We're looking to evaluate bottom life on the basis of mini-mill operation as opposed to the discontinuous foundry operation," said Joseph F. Kroker, manager of mechanical products for American Bridge.

"At Darlington, we expect to operate a minimum of 15 turns a week," said Mr. Kroker. "At the foundry we would operate only one turn a day and then only three or four days a week."

In the Brown-Boveri design, the bottom electrode or anode is formed by a large number of pins which are mounted on horizontal plates and which extend up through the hearth lining to the melt. The system is air cooled.

In the ASEA-Krupp system, the bottom electrode is a large copper plate which covers about the same area as the melt at the slag line. Current passes through the bottom refractories to the plate.

Apart from reducing graphite consumption, the single electrode furnace eliminates the need for flicker compensation.

"At the incoming, we have a balanced three-phase load," said Mr. Mueller of Brown Boveri. "The DC arc is stable. It does not extinguish." In an AC furnace, there is constant striking and breaking of arcs.

"Once a flat bath is reached, there is a very marked reduction in noise," said Mr. Kroker. "It's very quiet. Refractory erosion is much more uniform," he added.

"With one electrode in the center, you have no hot spots," explained Mr. Mueller.

Maintenance is reduced and pollution control is simplified. "You have only one opening in the roof," said Mr. Kroker.

PLASMA:
The word plasma, can refer to any gas that is conducting electricity.

Plasma furnaces are now operating at Voest-Alpine in Linz, Austria, and at the Siegan Works of Krupp Stahl, AG.

The 45-ton, DC furnace of Voest-Alpine was started in November of 1983 and has been in service since then. Krupp has a three-ton, three-phase, AC furnace and has plans for a 10-ton unit.

The Voest program has given promising results. "We think it has been very successful," said Hansjorg Wohlkonig of Voest.

"The main application we see for the moment is in producing quality steel grades," said Dr. Wohlkonig. "The advantage for quality steel is the higher metallic yield. Because of the inert argon atmosphere in the furnace, you have much less of the expensive alloying elements burning off."

He compared chromium yield of 97 pct with plasma to 85 pct with conventional arc melting.

The inert atmosphere can also eliminate the need for ladle degassing, said Wolfram Jung of Krupp Steel. There is an environmental advantage, Mr. Jung added.

"The plasma furnace burns not so loud," he said.

"It's very quiet compared to the arc," said Dr. Wohlkonig. The noise range of 80 to 90 db's with plasma is well under the 120 db's for arc furnaces, he noted.

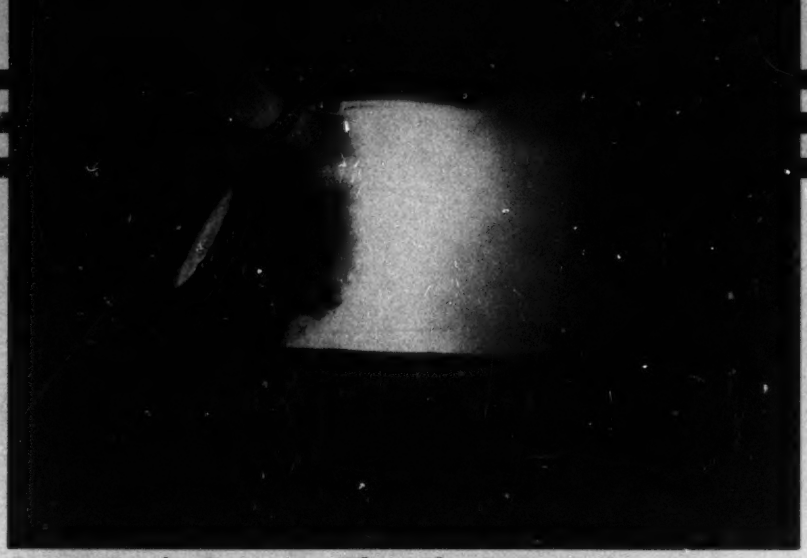
Closely related is the stability of plasma. "You don't have the constant short circuits," said Dr. Wohlkonig. "You don't have any shock loads."

This eliminates the need for flicker compensating equipment. In countries where the electrical grid is weak, the furnace power can be higher than with a conventional furnace.

In the Voest system, four plasma torches are mounted in the sides of the furnace and are aimed at the furnace bottom. "The plasma furnace is essentially an electric arc furnace without graphite electrodes," said Dr. Wohlkonig.

"These are replaced by plasma burners," he continued. "The cathode consists of a piece of tungsten, which wears out. We have a bottom electrode in the hearth." (Krupp's AC furnace has no bottom electrode.)

To get an economic comparison, Dr. Wohlkonig converted plasma



Bottom Tapping Furnaces—Where They're Located

1. Thyssen,	Germany	55 ton, 17 ft. dia.	36 MVA	CBT
2. Thyssen,	Germany	120 ton, 22 ft. dia.	75 MVA	CBT
3. DDS,	Denmark	120 ton, 22 ft. dia.	70 MVA	EBT
4. Elkem Spigerv.,	Norway	60 ton, 17 ft. dia.	45 MVA	CBT
5. Oregon Steel,	USA	85 ton, 19 ft. dia.	48 MVA	EBT
6. DDS,	Denmark	120 ton, 21 ft. dia.	66 MVA	EBT
7. SAFE,	France	135 ton, 22 ft. dia.	96 MVA	EBT
8. Raritan River Steel,	USA	165 ton, 20 ft. dia.	93 MVA	EBT
9. CAP,	Chile	25 ton, 12 ft. dia.	5 MVA	CBT
10. Berliner Works,	Germany	45 ton, 15 ft. dia.	24 MVA	EBT
11. SISMA,	Italy	70 ton, 19 ft. dia.	42 MVA	EBT
12. ALPA,	France	72 ton, 17 ft. dia.	45 MVA	EBT
13. British Steel,	England	180 ton, 24 ft. dia.	85 MVA	EBT
14. Thyssen,	Germany	155 ton, 22 ft. dia.	80 MVA	EBT
15. Cosigua,	Brazil	130 ton, 21 ft. dia.	85 MVA	EBT

EBT = Eccentric Bottom Tap
CBT = Concentric Bottom Tap
Source: Mannesmann Demag

costs to graphite terms. "You don't have any graphite consumption obviously," he said, "but you do have consumption of argon and of tungsten cathodes. You come to the equivalent of three kilograms per ton (of graphite electrode)."

That's about the same as the graphite consumption with a conventional furnace, he indicated. He was hopeful the plasma cost could be cut to a 1.4 kg equivalent.

The energy efficiency of plasma has been questioned on the basis of high radiation losses. Kr. Wohlkonig discussed the experience of Voest.

"We have an average of 600 kwh a ton," he said. "That is for doing all the metallurgical work—meltdown and refining. If you're talking about meltdown, we've reached values of 460 kwh. I think 460 compares quite well with conventional."

At this stage, Voest doesn't see plasma matching the speed of conventional furnaces on carbon steel. "If you're talking only carbon grades, the productivity of the furnace isn't yet at a level comparable to a modern ultra high power furnace."

For meltdown alone, the Voest furnace produced at the rate of about 20 tons an hour. Full refining would, of course, reduce output.

With intermittent operation, lining life has been running around 120 heats. Tests with sustained operation have indicated 220 heats can be expected.

Voest has reported a plasma burner life of 2,000 hours. "The wear of the plasma torch is improving," said Dr. Wohlkonig.

The word, plasma, can refer to any gas that is conducting electricity. ASEA now uses the phrase, DC Arc Plasma, for its single elecrode furnace. A conventional arc furnace makes plasma.

A number of new processes are employing plasma for iron making. Westinghouse Electric Corp. has been involved in programs for direct reduction and melting of iron.

ECCENTRIC BOTTOM TAPPING: Outside the U.S. there are thirteen electric furnaces with bottom tapping.

Coming up in the near future at Raritan River Steel Co. and Oregon Steel Mills are furnaces equipped for Eccentric Bottom Tapping (EBT).

Supplied by Mannesmann Demag Corp., EBT simplifies furnace construction and helps keep furnace slag from carrying over to the ladle.

Outside the U.S., there are thirteen electric furnaces with bottom tapping. Four of these employ the original design, which calls for tapping through a hole in the center of the bottom. This design reduces capital cost but it makes for slag carryover because of vortexing and because the flow can't be checked by tilting the furnace.

To get away from these problems, Mannesmann Demag shifted the tap hold to the rim of the bottom and provided a water cooled flap. In operation, the furnace is tilted 5 degree before opening the tap hole. Tapping is terminated by tilting the furnace backward and leaving a heel of 10 to 15 tons.

After tapping, the hole is cleaned with oxygen, the flap is closed and the hole is filled with a breeze material.

Advantages cited by Mannesmann Demag include reduced nitrogen pickup due to a short, compact stream; reduced temperature loss; and longer life for ladle refractories. These and other benefits are seen cutting operating costs by at least $4 a ton. □

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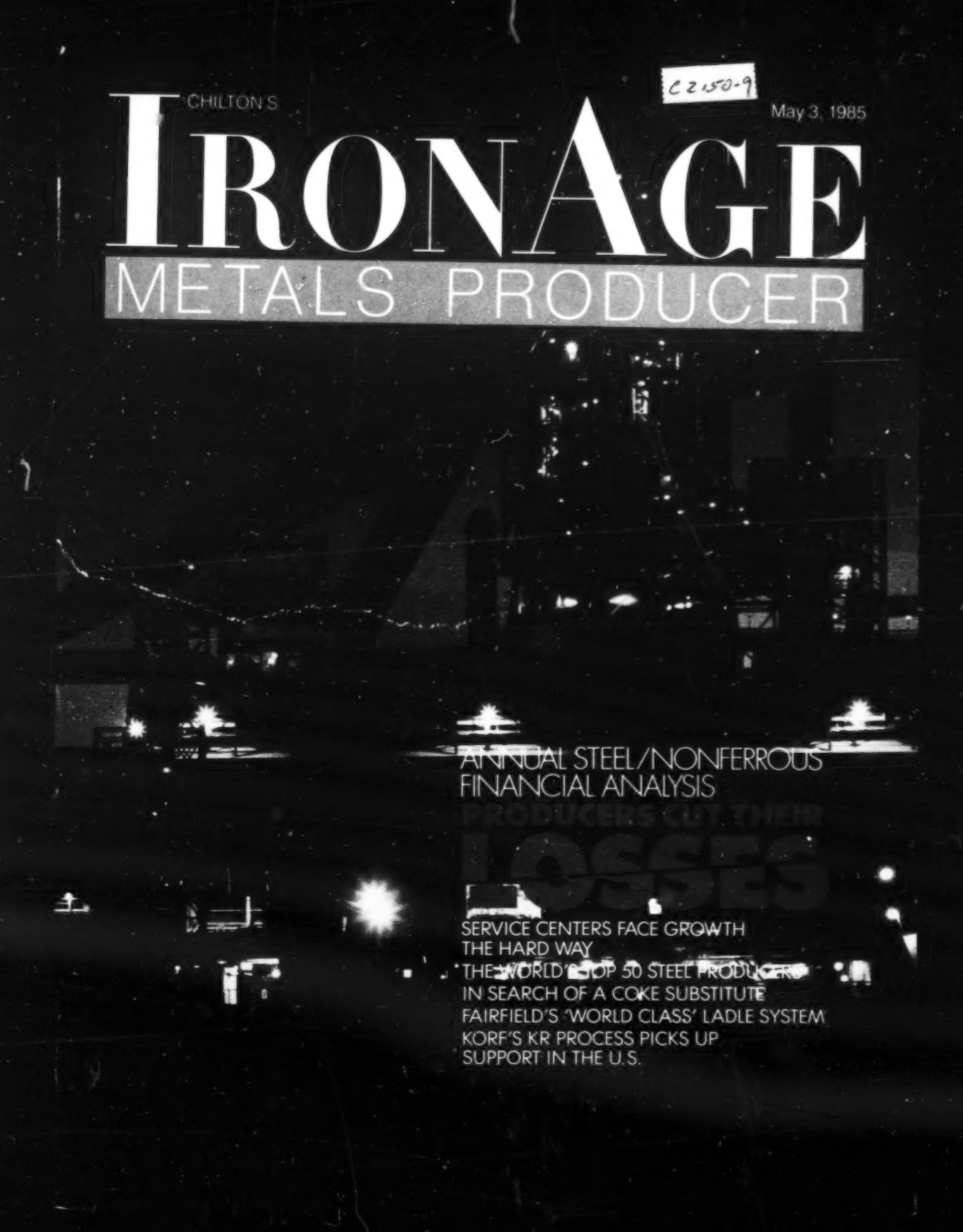

ANNUAL STEEL/NONFERROUS FINANCIAL ANALYSIS

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SERVICE CENTERS FACE GROWTH THE HARD WAY

THE WORLD'S TOP 50 STEEL PRODUCERS

IN SEARCH OF A COKE SUBSTITUTE

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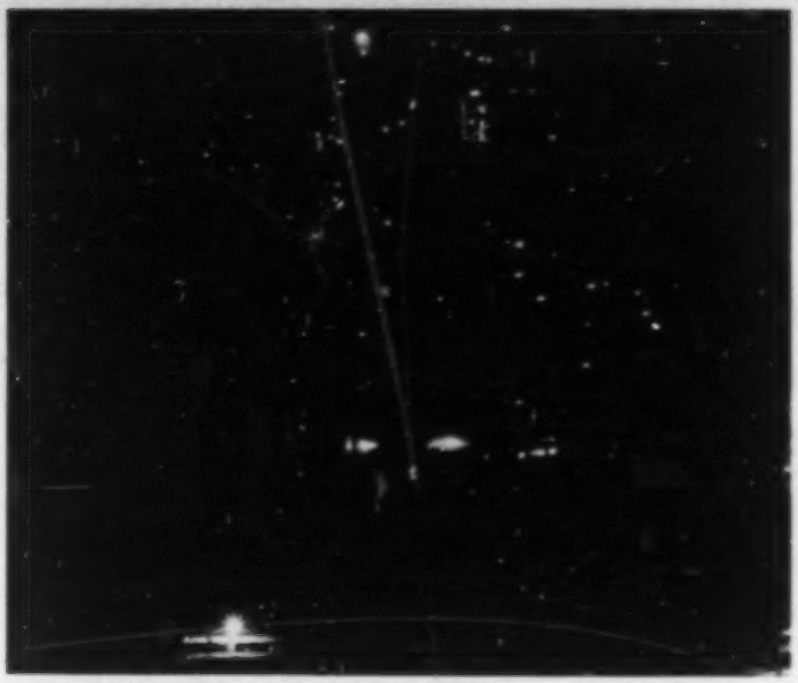

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IRON AGE'S 1984 TOP 50 WORLD STEEL PRODUCERS

BY JAMES B. POND

Our annual survey reveals that overcapacity is still a problem but that it is not a deterrent to efficiency or to modernization programs.

Words and pictures do not tell the story of the plight of the world's steel industry as well as the statistics do in laying the facts on the table for all to see.

Statistics can lie, of course, or can be made to misinform. However, no matter how one looks at the results of *Iron Age's* annual survey of the world's top 50 steel producers, the message is a tragic one filled with despair and frustration but also one with images of hope.

To begin with, world crude steel output rose to 710 million metric tons in 1984, according to the International Iron and Steel Institute (IISI). This was 46.7 million metric tons higher than that of 1983, a rise of 7 pct. The figures are preliminary, of course, and include the estimated production of the entire world.

For clarification and to establish perspectives, the *Iron Age* survey is of the large steel producers in Europe, the Orient, and the Americas. Production in the USSR and Comecon countries, and China are not included in the 1984 survey.

According to the IISI, the 710 million metric ton figure is 10.0 pct higher than 1983 and 4.9 pct below the previous peak of 746.7 million metric tons reached in 1979.

The IISI stated that much of the increase came from the developing countries "whose 1984 production rose to an all-time high of 70 million metric tons or 28.3 pct above their 1979 level."

The industrialized countries of the Western World produced 375.6 million metric tons in 1984, up 9.3 pct over 1983, the IISI year-end report said.

Overcapacity Prevails

Whether it be overcapacity or insufficient demand for steel, clearly the world's steel producers could supply a much larger market without difficulty. What better demonstration of this can be offered than a look at what I call the " The Least Fortunate Producers." This listing shows that twelve of the top 50 firms were running at 60 pct or worse utilization, on average, during 1984. The worst case was Bethlehem Steel in the U.S., which reported a 49.5 pct utilization factor.

Was this true? Not necessarily. How does one report maximum capacity or capability to produce steel? *Iron Age* has for the second year defined it as "The tonnage capability to produce raw steel for a sustained full order book," which was suggested by one of the top ranked steel companies several years ago and which has not been questioned by any respondents.

Nevertheless, capability is subject to interpretation and must be judged accordingly.

Utilization Is A Key

On the more positive side, there were nine of the top 50 companies that achieved 90 pct or better utilization of their facilities. Two companies reported that they actually produced more than their capacity, which seems contradictory if not downright impossible. At least on the surface. If maximum capacity, for example, is determined on a 48 or 50 week year, it would be possible to run additional production rather than shut down for maintenance. For comparative purposes, I rated each of these firms at 100 pct utilization.

Another sign of the times is evident in the listing of "The Most Fortunate Producers Based on Highest Utilization." Most are well below the ten million tons per year mark.

On the other hand, those firms that are considered "Least Fortunate" are also the leaders of the world steel industry, both in size and technology.

Nippon Steel, the world's leading producer of steel with a capability to produce 53 million metric tons of steel each year was running at 55.5 pct of capacity during 1984, on average.

This parallels the Japanese experience during 1984. The five Japanese steel producers listed in this "Least Fortunate" category had a capacity to produce 122 million metric tons of raw steel, but produced only 67.5 million metric tons for export and domestic use, for a 55.3 pct utilization factor. What frustration this must be for the workers, owners and government. Here they have gathered together the best technology, equipment and facilities in the world and the world market for steel collapses.

Rating The Best

Top production honors for "Most Tons Produced Per Employee" goes to a newcomer to *Iron Age's* survey: Tokyo Steel Manufacturing Co., Ltd. This producer is highly automated. It produced 2,896,000 metric tons in 1984 with only 1,974 employees engaged in steelmaking operations, for an amazing 1,467 tons per employee. In 1983 Tokyo Steel produced 1,358 tons per employee, according to the company.

Comparisons of "Tons Per Employee" have proved to be an illusive task due to the need to interpret who is engaged in steelmaking operations. In past surveys attempts were made to separate manufacturing and service operations of large multi-industry firms. Quite a num-

(Continued on p. 77)

World's Top 50 Steel Producers in 1984

1984 Rank	(1983 Rank)	Company (Country)	Year	Crude Steel Production (metric tons)	Maximum Capability (metric tons)	Exports As % of Shipments	No. of Employees (Steelmaking)	Tons per Employee	Capital Expenditures 1985 Forecast 1984 Actual (Millions)
1	(1)	Nippon Steel	1984	29,420,469	52,973,000	34.0	64,205	458	Yen 155K F1
		(Japan)	1983	26,852,802	54,514,000	36.0	64,100	419	Yen 170K F1
2	(2)	U. S. Steel	1984	13,680,000	22,800,000	1.0	33,360	386	$1,350
		(U.S.A.)	1983	13,440,000	28,409,000	1.0	44,559	301	$970
3	(4)	Finsider	1984	13,517,476	21,445,000	31.3	81,610	166	L 906.9K
		(Italy)	1983	12,165,039	21,617,000	32.5	94,130	129	L 542.3 K
4	(3)	British Steel	1984	13,400,000	21,400,000	27.9	50,700	264	£220 F1
		(England)	1983	11,700,000	21,200,000	26.9	56,100	209	£193 F1
5	(5)	NKK(Nippon Kokan)	1984	12,504,000	21,030,000	32.0	24,754	505	Yen 125K
		(Japan)	1983	11,411,000	21,030,000	33.0	25,337	450	Yen 103K
6	(10)	Thyssen Stahl	1984	11,740,000	N.A.	N.A.	N.A.	N.A.	N.A.
		(W. Germany)	1983	10,036,000	N.A.	N.A.	N.A.	N.A.	N.A.
7	(9)	SIDERBRÁS[1]	1984	11,389,000	12,577,000	35.3	49,198[2]	232	$1,629
		(Brazil)	1983	9,119,000	10,275,000	40.0	43,133[3]	211	$1,457
8	(7)	Sumitomo Metals	1984	11,302,602	21,680,000	39.4	27,748	407	Yen 80K F1
		(Japan)	1983	10,338,586	21,680,000	37.7	28,784	359	Yen 90K F1
9	(6)	Kawasaki Steel	1984	11,283,000	20,780,000	36.5	26,976	418	Yen 100K F1
		(Japan)	1983	10,358,000	20,780,000	38.9	28,037	369	Yen 120K F1
10	(8)	Bethlehem Steel	1984	9,699,725	19,636,019	1.0	33,927	325	$400
		(U.S.A.)	1983	9,699,725	19,636,019	1.0	35,052	277	$309
11	(11)	USINOR	1984	9,400,000	13,000,000	42.0	9,950	945	F 4K
		(France)	1983	8,600,000	14,600,000	40.0	10,661	807	F 3K
12	(12)	POSCO	1984	9,194,552	9,100,000	30.0	14,957	615	$699
		(S. Korea)	1983	8,438,100	9,100,000	30.0	14,488	582	$331
13	(13)	LTV	1984	9,000,000	N.A.	N.A.	N.A.	N.A.	N.A.
		(U.S.A.)	1983	6,985,000	11,800,000	N.A.	31,000	N.A.	N.A.
14	(16)	Kobe Steel	1984	6,618,000	8,807,000	31.0	12,711	521	Yen 578 F1
		(Japan)	1983	6,062,000	8,807,000	33.0	13,069	464	Yen 495 F1
15	(15)	SAIL	1984	6,300,000	N.A.	N.A.	N.A.	N.A.	N.A.
		(India)	1983	6,100,000	11,800,000	N.A.	31,000	190	N.A.
16	(14)	SACILOR	1984	6,235,000	8,300,000	53.0	63,950	97	FF 2.7
		(France)	1983	6,976,000	8,461,000	48.7	67,500	103	FF 2.7
17	(19)	Broken Hill Pty	1984	6,110,613	6,600,000	20.1	30,399	201	A$241 F4
		(Australia)	1983	5,519,000	7,620,000	28.6	31,328	176	A$123.7 F4
18	(17)	Inland Steel	1984	5,877,477	8,436,820	0	19,500	301	$210
		(U.S.A.)	1983	5,720,677	8,436,820	0	20,500	279	$185
19	(21)	ISCOR	1984	5,770,300	7,300,000	34.0	39,700	145	R170 F3
		(S. Africa)	1983	5,435,900	6,950,000	32.0	40,900	133	R260 F3
20	(20)	Armco	1984	5,560,208	7,200,000	1.4	19,355	287	$92.5
		(U.S.A.)	1983	5,430,933	7,200,000	1.3	21,986	247	$80.7
21	(26)	Hoogovens Groep	1984	5,532,000	7,200,000	69.6	17,607	314	DFL614
		(Netherlands	1983	4,277,000	7,200,000	67.4	17,850	240	DFL460
22	(23)	Cockerill Sambre	1984	4,835,000	N.A.	74.0[6]	19,334	250	N.A.
		(Belgium)	1983	4,724,000	N.A.	62.0[7]	21,241	222	BF 1,310
23	(22)	National Steel	1984	4,812,000	5,500,000	0	12,502	385	$255
		(U.S.A.)	1983	4,576,000	5,500,000	0	12,708	360	$75.5
24	(25)	STELCO	1984	4,667,783	7,259,550	22.1	20,612	226	N.A.
		(Canada)	1983	4,334,622	7,245,950	23.0	19,519	222	C$35
25	(28)	Krupp Stahl	1984	4,395,000	N.A.	30.0	22,362	196	N.A.
		(W. Germany)	1983	3,904,000	N.A.	29.0	22,954	170	DM165
26	(31)	Sidermex	1984	4,317,000	5,690,000	16.0	39,087	111	$109K
		(Mexico)	1983	3,777,102	5,690,000	18.0	38,846	97	63K
27	(24)	Klöckner-Werke	1984	4,300,000	N.A.	N.A.	N.A.	N.A.	N.A.
		(W. Germany)	1983	4,400,000	N.A.	N.A.	N.A.	N.A.	N.A.
28	(30)	ENSIDESA	1984	4,108,261	6,000,000	34.0	21,012	195	Pts 32,800
		(Spain)	1983	3,799,872	6,000,000	34.0	22,356	170	Pts 6,534
29	(27)	Hoesch Stahl	1984	4,109,000	4,889,000	28.0	17,800	231	DM579
		(W. Germany)	1983	3,929,000	4,889,000	27.0	19,000	207	DM376

TOP 50

World's Top 50 Steel Producers in 1984

1984 Rank	(1983 Rank)	Company (Country)	Year	Crude Steel Production (metric tons)	Maximum Capability (metric tons)	Exports As % of Shipments	No. of Employees (Steelmaking)	Tons per Employee	Capital Expenditures 1985 Forecast 1984 Actual (Millions)
30	(29)	Voest-Alpine	1984	4,444,651	N.A.	65.0	16,200	274	öS 2,100
		(Austria)	1983	4,057,130	N.A.	62.0	16,600	244	öS 1,030
31	(33)	DOFASCO	1984	4,053,000	4,148,000	13.7	13,200	307	C$825[4]
		(Canada)	1983	3,360,000	4,298,000	11.3	11,400	295	C$91
32	(36)	Mannesmann[5]	1984	3,988,000	N.A.	N.A.	N.A.	N.A.	N.A.
		(W. Germany)	1983	3,654,000	N.A.	N.A.	N.A.	N.A.	N.A.
33	(34)	Arbed S.A.	1984	3,900,000	4,600,000	96.0	12,200	320	FLux 2,560
		(Luxembourg)	1983	3,200,000	4,600,000	96.0	13,500	237	FLux 1,970
34	(35)	Peine-Salzgitter	1984	3,627,700	7,100,000	42.0	12,735	285	N.A.
		(W. Germany)	1983	3,122,200	7,100,000	39.1	14,132	221	N.A.
35	(39)	N.V. Sidmar	1984	3,355,815	3,500,000	91.0	5,411	523	BF3.5K
		(Belgium)	1983	2,813,254	3,500,000	89.0	6,306	446	BF1.5K
36	(32)	China Steel	1984	3,340,572	3,250,000	27.9	7,486	446	NT$ 10,045
		(Taiwan)	1983	3,411,010	3,250,000	33.0	7,554	452	NT$ 2,622
37	(42)	Nisshin Steel	1984	2,965,000	5,473,000	24.3	8,762	338	Y 25,800K F1
		(Japan)	1983	2,585,000	5,481,000	25.3	8,965	288	Yen 40,100K F1
38	(37)	COSIPA	1984	2,915,634	3,160,000	37.0	14,389	203	$390
		(Brazil)	1983	3,018,000	3,160,000	45.0	14,096	214	$340
39	(N)	Tokyo Steel	1984	2,896,000	3,720,000	24.0	1,974	1,467	Yen 3,000
		(Japan)	1983	2,729,000	2,890,000	42.0	2,010	1,358	Yen 35,845
40	(41)	Svenskt Stål	1984	2,857,000	3,100,000	41.0	11,500	248	SEK500
		(Sweden)	1983	2,587,000	3,100,000	38.0	11,350	228	SEK533
41	(46)	Wheeling-Pittsburgh	1984	2,550,000	4,000,000	0.01	10,700	238	N.A.
		(U.S.A.)	1983	2,020,000	4,000,000	0.01	11,500	176	$26.9
42	(44)	SIDOR	1984	2,511,000	4,800,000	32.0	15,566	161	B 1,028
		(Venezuela)	1983	2,159,000	4,800,000	42.0	15,446	140	B 203
43	(43)	Arbed Saarstahl	1984	2,462,000	3,700,000	40.0	14,427	171	DM 65
		(W. Germany)	1983	2,397,000	3,700,000	41.0	16,236	148	DM 70
44	(22)	Weirton Steel	1984	2,396,841	4,000,000	0.6	7,699	311	$74
		(U.S.A.)	1983	1,995,499	4,000,000	0.5	6,874	290	$38
45	(45)	Algoma Steel	1984	2,294,000	N.A.	N.A.	9,000	255	N.A.
		(Canada)	1983	2,092,000	N.A.	N.A.	N.A.	N.A.	N.A.
46	(47)	Tata Iron & Steel	1984	2,060,000	2,120,000	N.A.	65,100	32	Rs. 1,260 F1
		(India)	1983	1,935,000	2,120,000	N.A.	64,800	30	Rs. 520 F1
47	(48)	Rautaruukki Oy	1984	1,773,000	1,900,000	46.0	4,478	396	FMK 850
		(Finland)	1983	1,632,000	1,900,000	45.0	4,534	360	FMK 397
48	(50)	Nucor Steel	1984	1,568,000	2,100,000	>1.0	1,780	881	$26
		(U.S.A.)	1983	1,432,000	2,100,000	>1.0	1,820	787	$28
49	(N)	Daido Steel	1984	1,410,000	1,720,000	11.8	5,400	261	Yen 17,446
		(Japan)	1983	1,330,000	1,560,000	13.7	5,300	251	Yen 17,329
50	(49)	AHV	1984	1,143,000	1,530,000	23.0	9,337	122	Ptas9,728
		(Spain)	1983	1,377,000	1,530,000	29.0	9,533	144	N.A.

FOOTNOTES

(N) New listing
K Thousand (Thousand million = Billion)
F1 Fiscal Year April 1—March 31
F2 Fiscal Year October 1—September 30
F3 Fiscal Year July 1—June 30
F4 June 1—May 31
[1] Sidebrás System, including USIMINAS and CSN
[2] Excludes ACOMINAS, which was under construction in '83 and '84
[3] Excludes CST and ACOMINAS. CST start-up was in Nov. '83
[4] Current program extends to late '80s
[5] Production primarily for internal use
[6] Exported 52 pct to EEC and 22 pct to others
[7] Exported 44 pct to EEC and 18 pct to others

Company Names Behind The Acronyms.

AHV — Altos Hornos de Vizcaya S.A.
COPSIPA — Companhia Siderúrgica Paulista
DOFASCO — Dominion Foundries & Steel Ltd.
INSIDESA — Empresa Nacional Siderúrgica, S.A.
ISCOR — S. African Iron & Steel Industrial Corp., Ltd.
POSCO — Pohang Iron and Steel Company Ltd
SACILOR — Aciéries et Laminoirs de Lorraine
SAIL — Steel Authority of India, Ltd.
SIDERBRÁS — Siderurgia Brasileira S.A.
SIDOR — C.V.G. Siderurgica del Orinoco C.A.
STELCO — The Steel Company of Canada, Ltd.
USINOR — Union Sidérurgique du Nord et de l'Est de la France

ber of firms could not, or would not, give a breakout. Other firms were purists and only reported persons directly involved in the steel production process.

To clarify the intent of how the survey results would be used, each recipient received copies of the 1983 *Iron Age* summary.

In view of what has been said previously about the plight of the Japanese steel companies, it is very significant that six of the top ten producers in 1984, based on "Tons Produced Per Employee," were Japanese. It indicates that size need not limit efficiency.

What About The People?

In view of the world overcapacity problem, it seemed inappropriate to cheer on the firms that were growing in size and number of people employed.

By the same token it seemed not quite right to cheer on those firms that were reducing payrolls in the name of efficiency. Nevertheless, the latter choice was selected to indicate where the rationalization of the steel industry is taking place and which firms are actually reducing staff and by how much.

British Steel and U.S. Steel again were in the rankings. In 1982, British Steel had a total of 103,700 employees. In 1983, 81,100; and in 1984, 71,100. The figure used this year for calculating its efficiency for just steel production was 50,700 persons. A comparable figure for the 1983 production results should have been 56,100 employees.

U.S. Steel Corp. also reduced staff during 1984 and made corrections to its reported figures. Thus, it reduced staff from 62,787 in 1982 to 44,559 in 1983 and 33,360 in 1984. And, more is planend.

Finsider continued its staff reduction program, which stood at 99,700 person in 1982; 94,100 in 1983; and 81,610 in 1984.

The majority of the firms that reduced employment during the year reported modest reductions of less than 6 pct. Only a few firms reported increases in total employment.

Best Management Rewarded

Proudest of the entire group in

1984 Top Ten Producers

Based on Tons Produced Per Employee

	Ranking	Company	Country	1984	1983
1	(39)	Tokyo Steel	(Japan)	1,475	1,358
2	(11)	USINOR	(France)	945	807
3	(48)	Nucor	(U.S.A.)	881	787
4	(12)	Pohang	(S. Korea)	615	582
5	(35)	Sidmar	(Belgium)	523	446
6	(14)	Kobe Steel	(Japan)	521	464
7	(5)	NKK	(Japan)	505	450
8	(1)	Nippon Steel	(Japan)	458	419
9	(8)	Kawasaki Steel	(Japan)	418	369
10	(7)	Sumitomo Metals	(Japan)	397	359

Steel Producers That Improved Production in 1984

Based on raw steel production by tonnage

		Company	1984-1983 (million tons)	Change (percentage)
1	(21)	Hoogovens	5.5 — 4.3	27.9
2	(7)	Siderbrás	11.4 — 9.1	25.3
3	(41)	Wheeling-Pittsburgh	2.5 — 2.0	25.0
4	(13)	LTV	9.0 — 7.0	22.2
5	(33)	Arbed S.A.	3.9 — 3.2	21.9
6	(44)	Weirton	2.4 — 2.0	20.0
7	(31)	Dofasco	4.0 — 3.4	17.6
8	(6)	Thyssen	11.7 — 10.0	17.0
9	(4)	British Steel	13.4 — 11.7	14.5
10	(26)	Sidermex	4.3 — 3.8	13.2

Best Productivity Improvement 1984 Versus 1983 (Tons/Employee)

Rank		Company	Tons/Employee 1983 — 1984	%
1	(41)	Wheeling-Pittsburgh	176 — 238	35.2
2	(33)	Arbed S.A.	237 — 320	35.0
3	(21)	Hoogovens Groep	240 — 314	30.8
4	(34)	Peine-Salzgitter	221 — 285	28.9
5	(3)	Finsider	129 — 166	28.7
6	(4)	British Steel	209 — 264	26.3
7	(2)	U.S. Steel	301 — 366	21.6
8	(37)	Nisshin Steel	288 — 338	17.4
9	(35)	Sidmar	446 — 523	17.3
10	(10)	Bethlehem Steel	277 — 325	17.3

TOP 50

Firms That Shrank in 1984 By Decreasing Employment

Rank		Company	1983 — 1984	% Change
1	(2)	U.S. Steel	44,559 — 33,360	25.1
2	(3)	Finsider	94,130 — 81,610	13.3
3	(43)	Arbed Saarstahl	16,236 — 14,427	11.1
4	(34)	Peine-Salzgitter	14,132 — 12.735	9.9
5	(4)	British Steel	56,100 — 50,700	9.6
6	(33)	Arbed S.A.	13,500 — 12,200	9.6
7	(22)	Cockerill Sambre	21,241 — 19,334	9.0
8	(28)	Hoesch Stahl	19,000 — 17,800	6.3
9	(27)	ENSIDESA	22,356 — 21,012	6.0
10	(16)	SACILOR	67,500 — 63,950	5.3

The Most Fortunate Producers Based on Highest Utilization

Rank		Company	Capacity — Production	% Change
1	(12)	POSCO	9.11 — 9.2	100.0
2	(36)	China Steel	3.3 — 3.3	100.0
3	(35)	Sidmar	3.5 — 3.4	97.2
4	(31)	Dofasco	4.2 — 4.0	95.2
5	(47)	Rautaruukki Oy	1.9 — 1.8	94.7
6	(40)	Svenskt Stål	3.1 — 2.9	93.5
7	(17)	BHP	6.6 — 6.1	92.4
8	(38)	COSIPA	3.2 — 2.9	90.6
9	(6)	Siderbrás	12.6 — 11.4	90.5

The Least Fortunate Producers Based on Lowest Utilization

Rank		Company	Capacity — Production	% Change
1	(10)	Bethlehem Steel	19.6 — 9.7	49.5
2	(34)	Peine-Salzgitter	7.1 — 3.6	50.7
3	(7)	Sumitomo Metals	21.7 — 11.3	52.1
4	(42)	SIDOR	4.8 — 2.5	52.1
5	(8)	Kawasaki Steel	20.8 — 11.3	54.3
6	(37)	Nisshin Steel	5.5 — 3.0	54.6
7	(1)	Nippon Steel	53.0 — 29.4	55.5
8	(5)	NKK	21.0 — 12.5	59.5
9	(44)	Weirton Steel	4.0 — 2.4	60.0
10	(2)	U.S. Steel	22.8 — 13.7	60.1
11	(3)	Finsider	21.4 — 13.5	63.1
12	(41)	Wheeling-Pittsburgh	4.0 — 2.6	65.0

the eyes of management are those ranked in the category "Best Productivity Improvement, 1984 Versus 1983 (Tons/Employee)."

This is the real stuff; the proof of the managerial pudding. Topping the list for 1984 is Wheeling-Pittsburgh Steel with a 35.2 pct improvement. Following closely is Arbed S.A., with 35.0 pct and the Hoogovens Groep with 30.8 pct.

Look closely here. U. S. Steel, Finsider, and British Steel, which ranked 2,3, and 4 in raw steel production in 1984, are right in there. Their efforts to increase productivity through shutdowns of inefficient plants and processes plus staff reductions are paying off, much to the discomfort of idled staff and the cheers of stockholders.

Exports, A Way of Life

"Exports as a percentage of shipments " adds to the complete portrait of the world's steel industry. Not surprisingly, most U.S. steel producers included in this survey export little or no steel. European firms rely heavily on exports, which is understandable in view of the relatively small size of their countries and their limited domestic markets. So, large or small, these companies tend to be heavy exporters.

Japanese steel producers perhaps could have increased exports as a percentage of shipments but, under the threat of protectionism and other restraints on free trade, generally were limited to about a third of shipments. Unfortunately, domestic demand for steel was not strong enough to allow higher and more profitable utilization rates.

In fairness to all concerned, it was decided not to make a contest out of which company exported the most, or the least, as a percentage of shipments. The figures are nevertheless interesting and important. They will give legislators in concerned governments a clearer view of the interplay among marketing forces and economic well being. And, hopefully, it serves notice on nations that use the steel industry as a national symbol of strength and spirit that adding to an overflowing pot does little more than dampen the fire further. □